August 1973

B73-10217

NASA TECH BRIEF

Marshall Space Flight Center

Integrated P-Channel MOS Gyrator

An integrated, metal oxide semiconductor (MOS) gyrator uses only p-channel FET's. This allows it to be produced by a relatively simple and inexpensive process. Several of these circuits can be integrated into one chip for applications which require more than one gyrator. In addition, they can be integrated with other p-channel MOS circuits to eliminate the need for external connections.

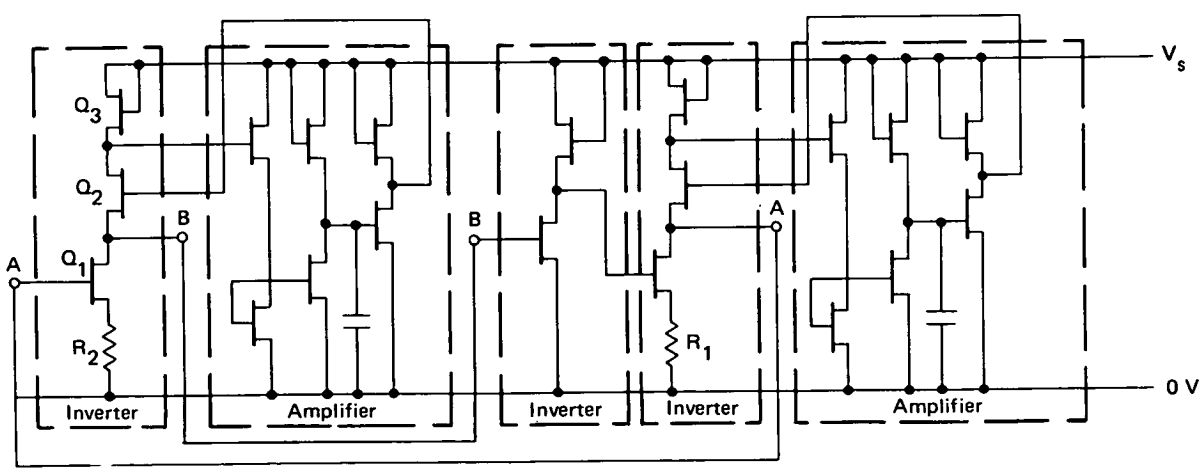
The devices can operate at economical low-power levels, because they use FET amplifiers that do not degrade with decreases in supply or drain currents. The key feature of the circuit is the enhancement, through feedback, of the resistance of the current sources supplying the drain current of the actual amplifier transistors.

The gyrator circuit is shown in the illustration. It is a voltage-controlled current source (VCCS) gyrator with two amplifiers. One inverting and one noninverting amplifier are connected in a feedback loop. The input and output resistances are high enough so that the circuit is responsive to voltage and not to current at the input.

The high input and output resistances of the MOSFET's are inversely proportional to the drain current. This means that the voltage gain increases with a decreasing drain current of approximately 10 to 15 μA. However, in order not to reduce the voltage gain excessively and to maintain a high output resistance, the VCCS dc drain current must have a current source. This is normally supplied by a transistor of opposite conductivity, but this circuit obtains the current through negative feedback.

The small dc current that feeds into the current source develops a voltage across the resistance of transistor Q3. This voltage is amplified and fed back to transistor Q2, producing a very high impedance.

Assemblies 1 and 2 in the illustration are the inverting VCCS; the noninverting VCCS consists of assemblies 3, 4, and 5. Except for the additional inverter in assembly 3, the noninverting VCCS is identical to the inverting one. This additional inverter is not stabilized by feedback, but utilizes the inherent stability of the voltage gain in p-channel MOS amplifiers. A and B in the illustration are input/output terminals.



P-Channel MOS Gyrator

(continued overleaf)

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
Code A&PS-TU
Marshall Space Flight Center, Alabama 35812
Reference B73-10217

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
Marshall Space Flight Center
Code A&PS-PAT
Marshall Space Flight Center, Alabama 35812

Source: E. Hochmair of
The National Academy of Sciences
under contract to
Marshall Space Flight Center
(MFS-22343)